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US 4290838 A

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INT CL[5] B32B 18/00 31/00 31/20 , H01G 4/30 13/00
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(54) Heat-pressing laminate of ceramic sheets

(57) A laminate (1) of ceramic sheets is heat-pressed by using a pair of heating press dies (4, 5) for heat-pressing the laminate (1) in the direction of lamination. The heat-pressing apparatus further comprises a sealing sleeve (21) for forming a hermetically closed space which entirely encloses the laminate (1) interposed between the pair of press dies (4, 5), and a vacuum source (15) for evacuating the hermetically closed space.

Fig.5

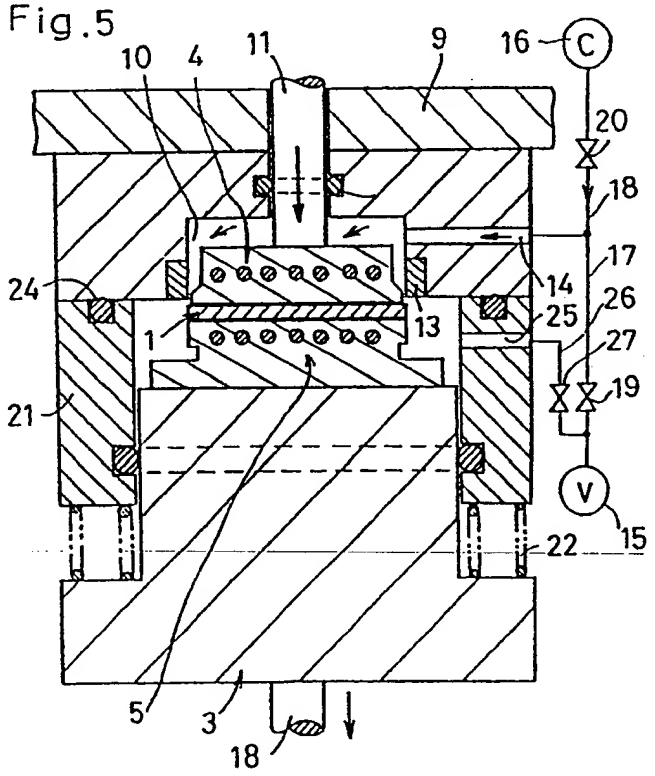

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Fig.1

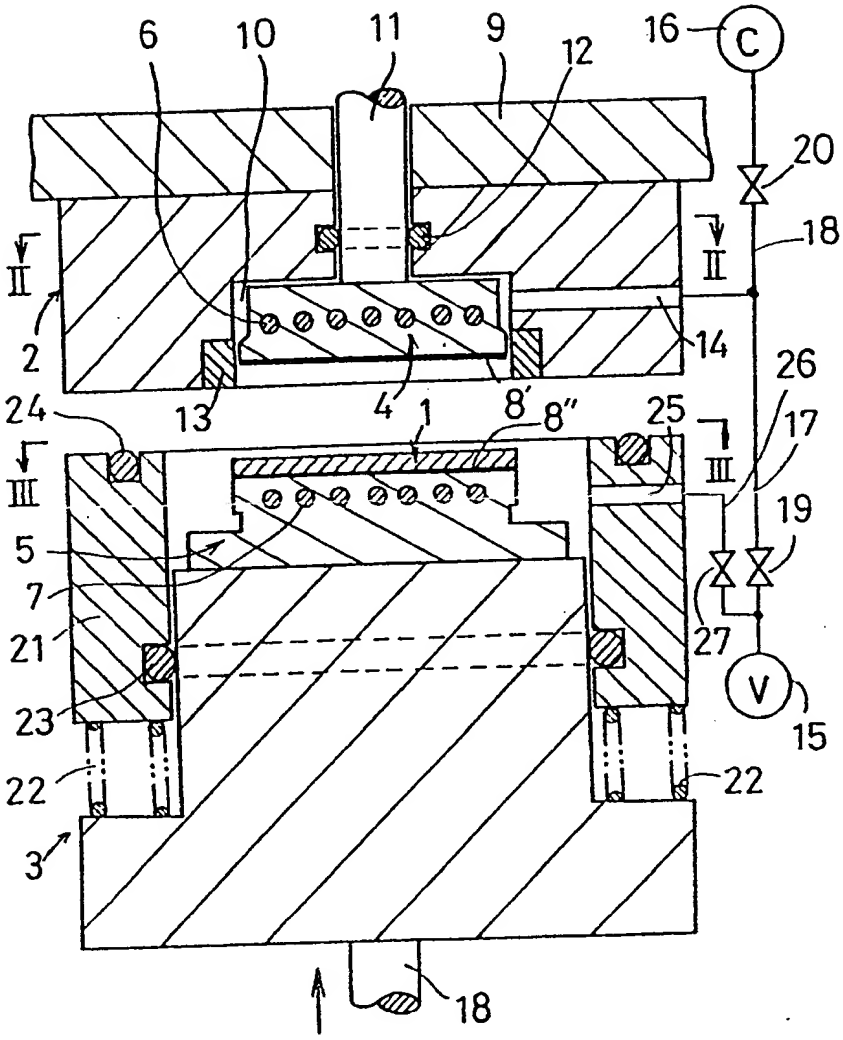

6
10
11
9
12
16
C
20
18
II
II
2
14
26
24
13
4
1
8'
8"
25
17
III
III
19
5
7
21
27
V
15
23
22
22
3
18

Fig. 2

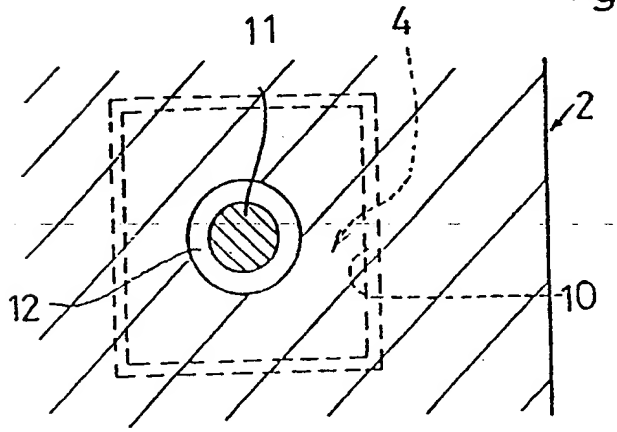

11
4
2
12
10

Fig.3

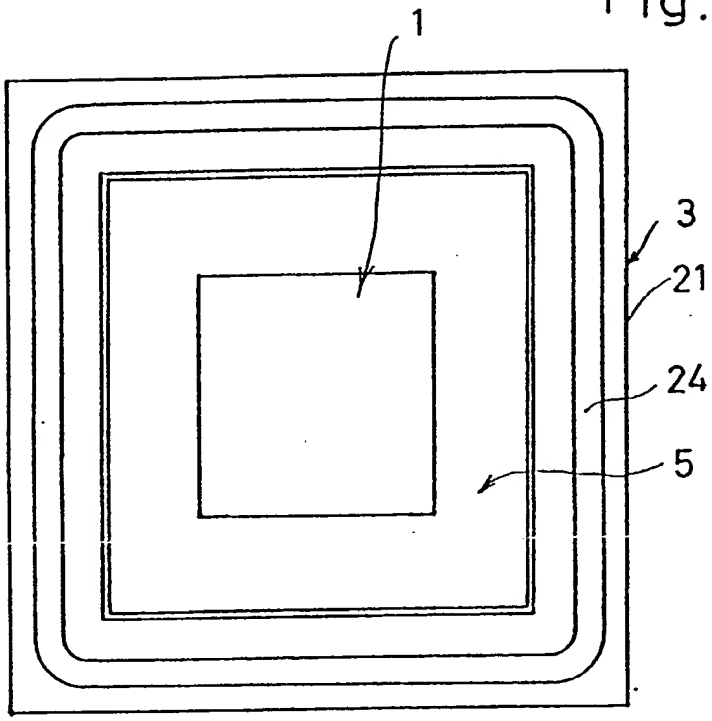


Fig.4

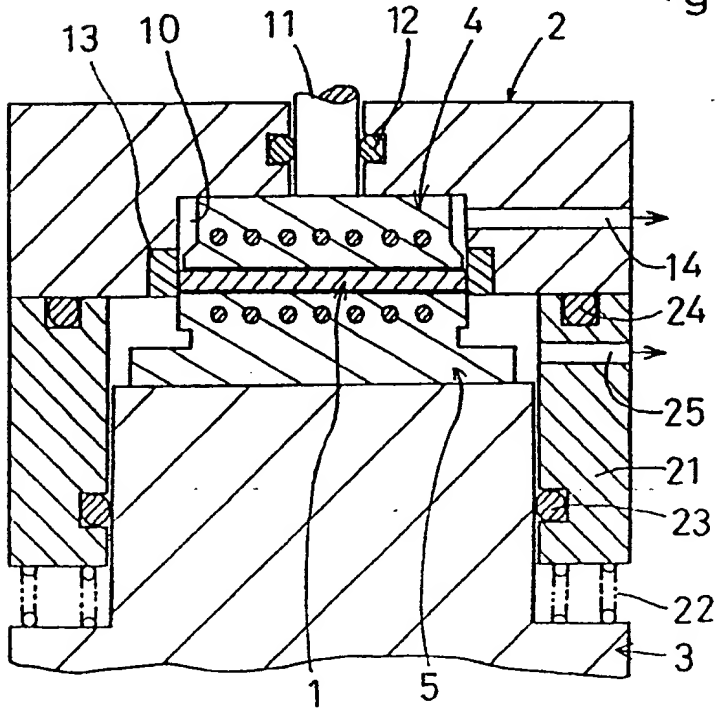


Fig.5

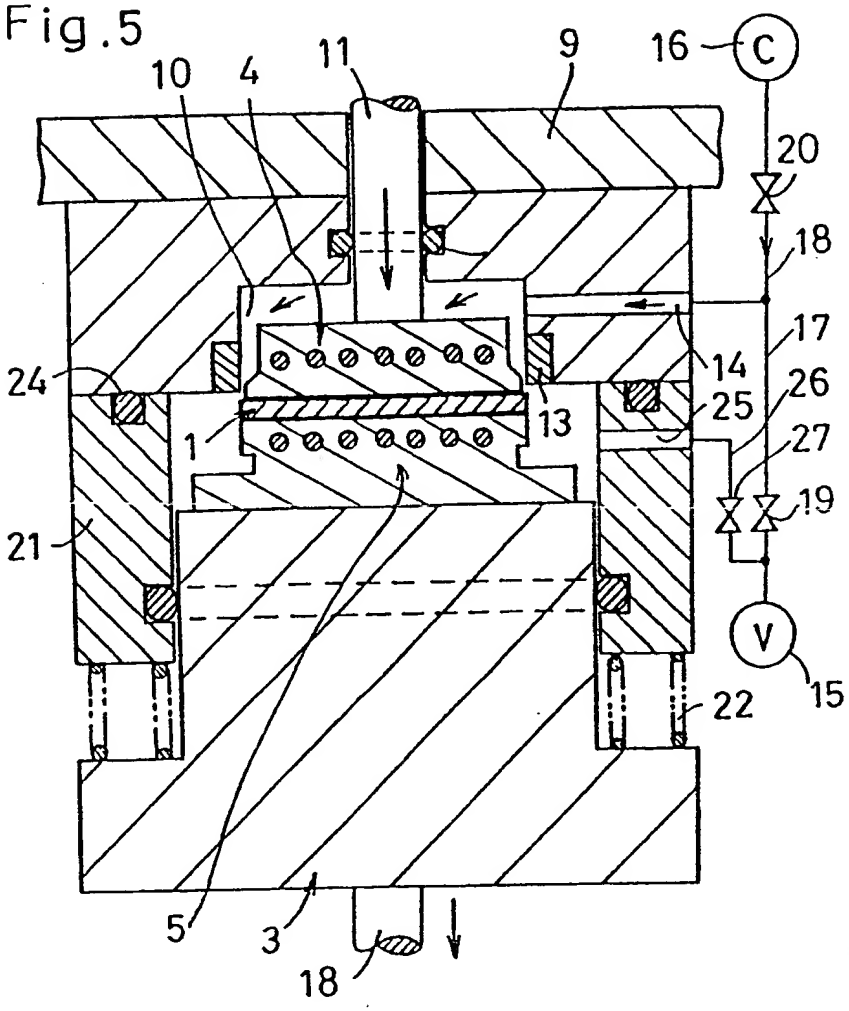

10
4
11
9
16
C
20
18
17
14
26
25
27
19
V
15
22
24
1
13
21
5
3
18

Fig.6

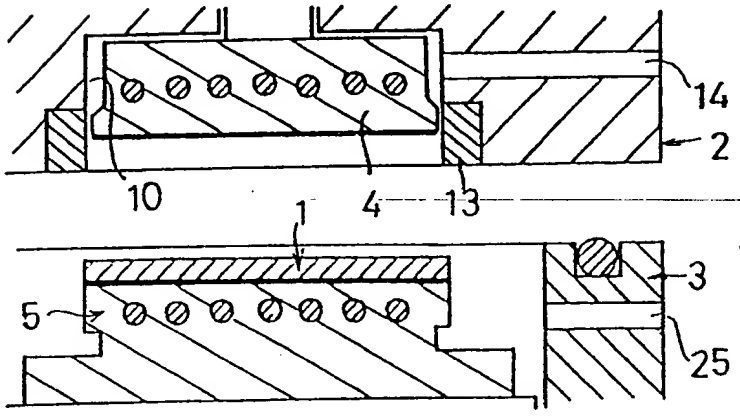

14
2
10
4
13
1
3
5
25

Fig.7

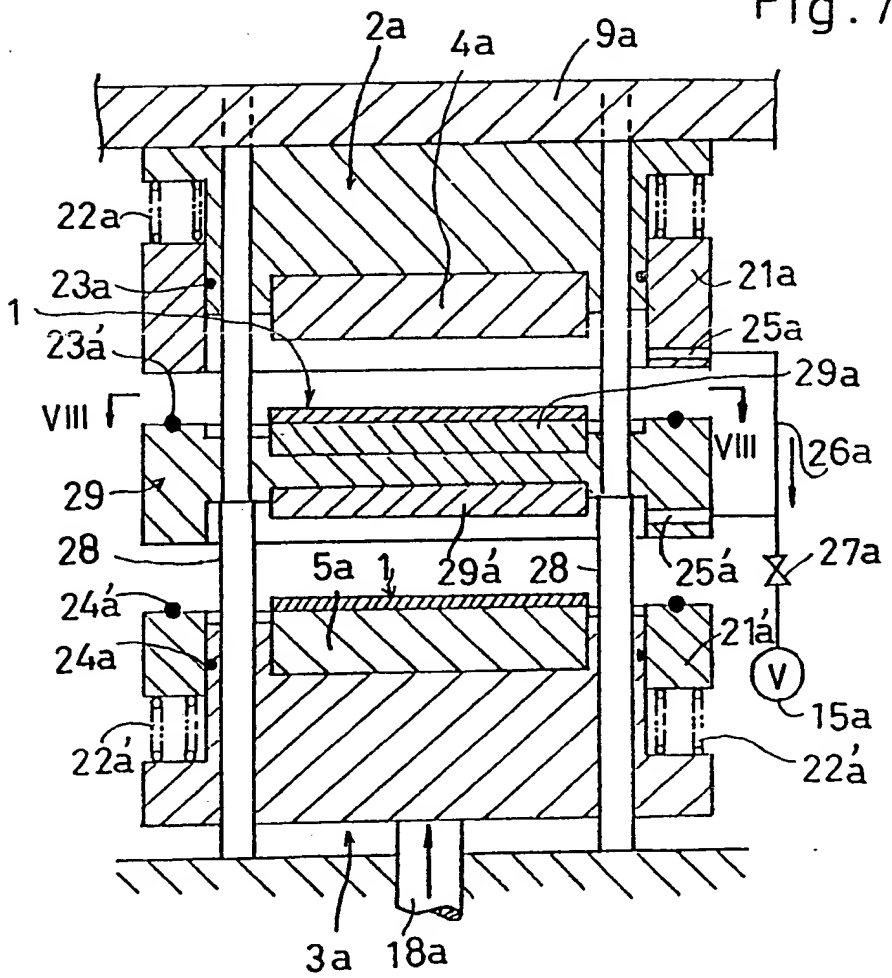

2a
4a
9a
22a
23a
1
23á
VIII
29
28
24á
24a
22á
5a
1
29á
28
25á
27a
21a
25a
29a
VIII
26a
21á
V
15a
22á
3a
18a

Fig.8

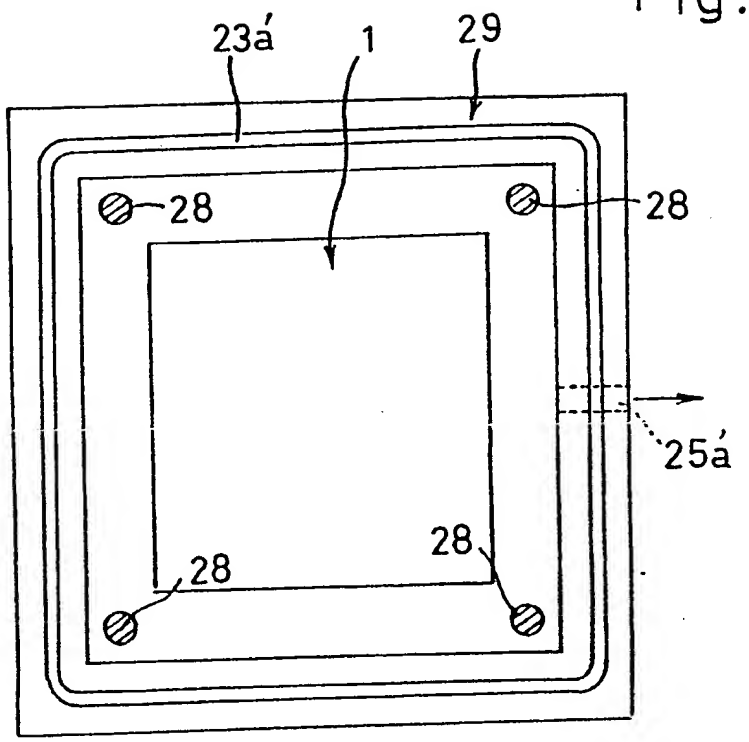


Fig.9

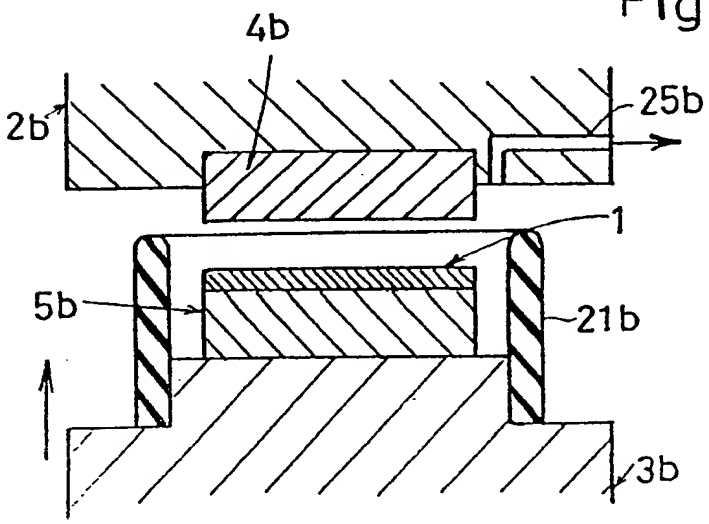


Fig.10

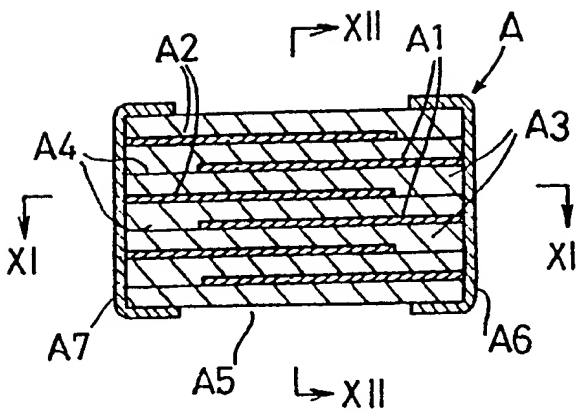


Fig.11

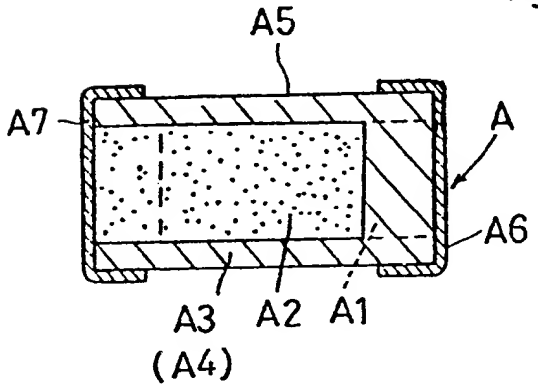


Fig.12

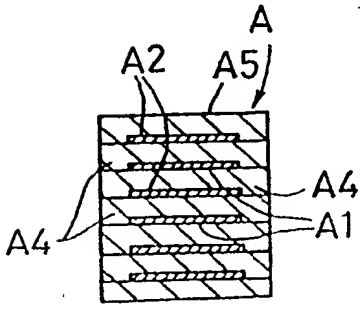
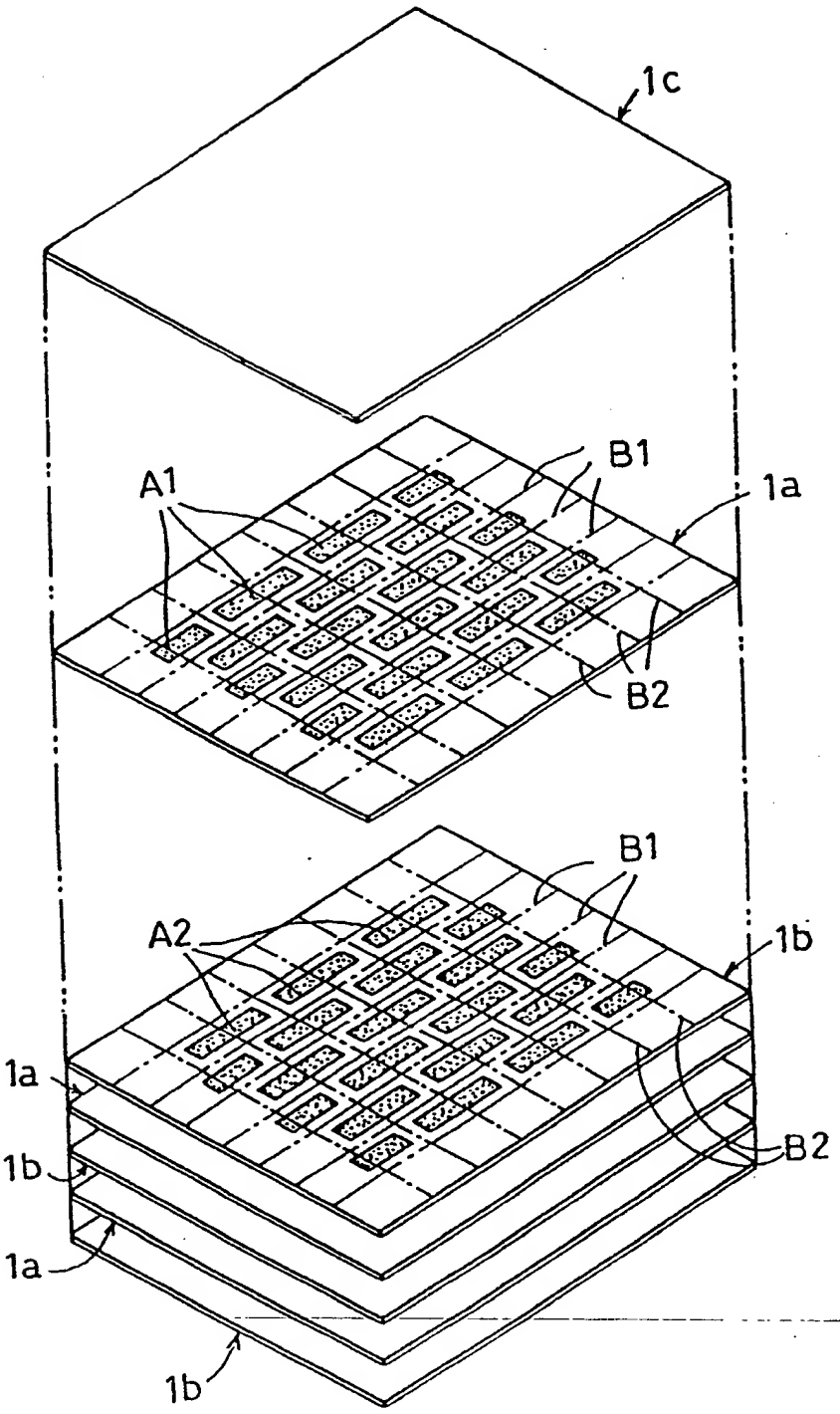


Fig.13



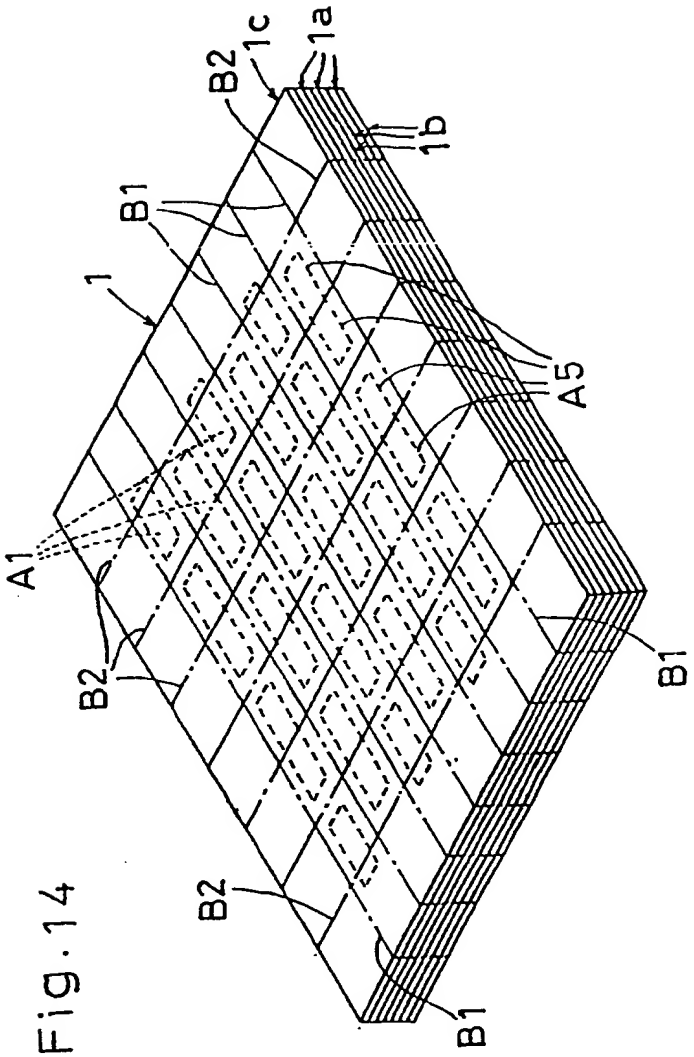


Fig. 14

METHOD AND APPARATUS FOR HEAT-PRESSING LAMINATE OF CERAMIC SHEETS

This invention relates to a method and apparatus for heat-pressing a laminate of ceramic sheets which may be used for making laminate ceramic chip capacitors for example.

As shown in Figs. 10 to 12 of the accompanying drawings, a laminate ceramic chip capacitor A generally has a first group of ceramic layers A3 which are formed with respective internal electrodes A1 offset in one direction (rightward in Fig. 10), and a second group of ceramic layers A4 which are formed with respective internal electrodes A2 offset in the opposite direction (leftward in Fig. 10). The first group layers A3 are laminated alternately with the second group layers A4 to provide an integral laminate body A5. The internal electrodes A1 for the first group layers A3 are commonly connected to a first external electrode A6, whereas the internal electrodes A2 for the second group layers A4 are commonly connected to a second external electrode A7 opposite in polarity to the first external electrode A6.

Such a chip capacitor may be manufactured according to the method disclosed in JP-A1-61(1986)-144811 or JP-A1-1(1989)-312817 for example.

According to the known method, as shown in Fig. 13, use is made of a first group of non-baked ceramic sheets 1a (green sheets) each having a surface formed with a multiplicity of first group internal electrodes A1, and a second group of non-

baked ceramic sheets 1b (green sheets) each having a surface formed with a multiplicity of second group internal electrodes A2. The first group sheets 1a are alternately laminated with the second group sheets 1b in a manner such that the first group internal electrodes A1 are staggered with respect to the second group internal electrodes A2. Further, an additional green ceramic sheet 1c is superposed on the highest one of the first group sheets 1a.

Then, as shown in Fig. 14, the ceramic sheet laminate 1 thus obtained is pressed in the direction of lamination for integration under heating. Such a process step is referred to as "heat-pressing".

Then, as also shown in Fig. 14, the laminate 1 is divided into a multiplicity of laminate ceramic chips A5 by cutting along lines B1, B2 in a lattice-like fashion.

Finally, each of the ceramic chips A5 is baked in a baking oven (not shown), and external electrodes A6, A7 (see Figs. 10 and 11) are formed on both ends of the chip A5 to provide a desired product.

In the known method, it has been found that the laminate 1 inevitably contains volatile substances and/or air between the respective ceramic sheets 1a, 1b, 1c. Thus, if the heat-pressing step is performed rapidly, these impurities remain within the laminate 1 as foams which might cause separation between the laminated ceramic sheets, thereby resulting in a quality deterioration.

Such a problem may be reduced by performing the heat-

pressing step for a prolonged period. However, this solution gives rise to a new problem of reducing the productivity. Further, such a solution has a limitation on the degree of foam removal.

It is, therefore, an object of the present invention to provide a method and apparatus for heat-pressing a laminate of ceramic sheets with a much higher productivity but without quality deterioration resulting from foam formation.

According to one aspect of the present invention, there is provided a method for heat-pressing a laminate of ceramic sheets in the direction of lamination by a pair of press dies each provided with a heater, characterised in that the method comprises the steps of: forming a hermetically closed space which entirely encloses the laminate interposed between the pair of press dies; evacuating the hermetically closed space; and heat-pressing the laminate between the pair of press dies.

With the method described above, the volatile substances and/or air existing between the laminated sheets can be positively removed in a short time by the evacuation (namely, the application of vacuum). Thus, it is possible to greatly reduce the time required for heat-pressing the ceramic sheet laminate in addition to preventing a quality deterioration which would be caused by foam formation. Further, foreign substances, such as dust, deposited on the surfaces of the laminate and/or press dies can be also removed by the evacuation, thereby providing additional prevention of quality deterioration.

According to another aspect of the present invention, there is provided an apparatus for heat-pressing a laminate of ceramic sheets comprising a pair of press dies for pressing the laminate in the direction of lamination, each of the press dies being provided with a heater, characterised in that the apparatus further comprises: a sealing sleeve for forming a hermetically closed space which entirely encloses the laminate interposed between the pair of press dies; and means for evacuating the hermetically closed space.

According to a preferred embodiment of the present invention, the sealing sleeve is mounted on a first head which supports one of the press dies, whereas the other press die is supported by a second head. Further, at least one of the first and second heads may be rendered movable for bringing the pair of press dies toward and away from each other, thereby causing the sealing sleeve to come into sealing contact with the second head for forming the hermetically closed space when the pair of press dies are brought toward each other for heat-pressing the laminate.

The sealing sleeve may be slidably mounted on the first head and elastically supported by springs. Alternatively, the sealing sleeve itself may be made of a relatively soft elastic material.

It is advantageous that one of the press dies is supported on a head which is formed with a recess, and said one press die is rendered projectable from and retractable into the recess. In this case, the open mouth of the recess may receive a frame

die into which the other press die is insertable, so that the frame die cooperates with said other press die for trimming the outer periphery of the laminate when said other press die is inserted into the frame die.

It is also advantageous if means is further provided for for supplying compressed air into the recess when the other press die retreats out of the frame die. Such an arrangement provides a cleaning function for removing the chips or fragments which would result at the time of trimming the outer periphery of the laminate.

According to another preferred embodiment, the heat-pressing apparatus further comprises: an additional pair of press dies for pressing an additional laminate of ceramic sheets in the direction of lamination, each of the additional pair of press dies being provided with a heater; an additional sealing sleeve for forming another hermetically closed space which entirely encloses the additional laminate interposed between the additional pair of press dies; and means for evacuating said another closed space.

The present invention will be more concretely described below on the basis of preferred embodiments given with reference to the accompanying drawings, in which:

Fig. 1 is a vertical sectional view showing a heater press according to a first embodiment of the present invention in a codition for introducing a ceramic sheet laminate;

Fig. 2 is a fragmentary sectional view taken along lines II-II in Fig. 1;

Fig. 3 is a view of the same heater press as seen in the direction of arrows III-III in Fig. 1;

Fig. 4 is a fragmentary sectional view similar to Fig. 1 but showing the same heater press at the time of heat-pressing the ceramic sheet laminate;

Fig. 5 is a sectional view similar to Fig. 1 but showing the same heater press in a condition for introducing compressed air;

Fig. 6 is a fragmentary sectional view showing the same heater press in a condition for taking out the heat-pressed ceramic sheet laminate;

Fig. 7 is a vertial sectional view showing a heater press according to a second embodiment of the present invention;

Fig. 8 is a view showing the heater press of Fig. 7 as seen in the direction of arrows VIII-VIII in Fig. 7;

Fig. 9 is a fragmentary vertical sectional view showing another heater embodying the present invention;

Fig. 10 is a sectional view showing a laminate ceramic chip capacitor to which the present invention may be applied;

Fig. 11 is a sectional view taken along lines XI-XI in Fig. 10;

Fig. 12 is a sectional view taken along lines XII-XII in Fig. 10;

Fig. 13 is a perspective view showing a plurality of ceramic sheets before lamination; and

Fig. 14 is a perspective view showing the ceramic sheets after lamination as a material for making laminate ceramic chip

capacitors.

Referring first to Figs. 1 to 3 of the accompanying drawings, there is shown a heater press for a laminate of ceramic sheets according to a first embodiment of the present invention. The ceramic sheet laminate may have the same configuration as the prior art ceramic sheet laminate 1 shown in Fig. 14. Such a ceramic sheet laminate may be used for making laminate ceramic chip capacitors (like the one shown in Figs. 10 to 12).

The heater press of the first embodiment comprises an upper head 2 which is fixed to the underside of a stationary machine frame 9. The heater press also comprises a lower head 3 which is moved vertically by a hydraulically driven plunger 18 (lower plunger).

The upper head 2 is formed with a downwardly open recess 10 for receiving an upper heating press die 4 fixed to another plunger 11 (upper plunger). The configuration of the recess 10 may be square or rectangular (see Fig. 2). The upper heating press die 4 is provided with an embedded heater 6. The upper plunger 11 penetrates vertically through the upper head 2 and the machine frame 9 and is movable by e.g. a hydraulic cylinder device for vertically reciprocating the upper press die 4. The upper plunger 11 is fitted with a seal ring 12 for sealing against the upper head 2.

On the other hand, the lower head 3 has an upwardly projecting central portion for mounting a lower heating press die 5 which is provided with an embeded heater 7. The size of

the lower press die 5 corresponds substantially to that of the recess 10 of the upper press die 4.

The upper heating press die 4 has a lower surface provided with a releasable sheet 8'. Similarly, the lower heating press die 5 is also covered by a releable sheet 8". In this way, a ceramic sheet laminate 1 will not adhere to the respective press dies 4, 5 when pressed therebetween under heating. Apparently, if the nature of the ceramic sheet laminate 1 is non-adherent or reluctantly adherent to the respective press dies 4, 5, the releasable sheets 8', 8" may be dispensed with.

As shown in Fig. 1, the upper press die 4 normally retreats in the recess 10 of the upper head 2 by an amount corresponding to the thickness of the ceramic sheet laminate 1. The recess 10 has an open mouth fitted with a frame die 13 which is square or rectangular in cross section for snugly receiving the lower press die 5. The frame die 13 and the lower press die 5 cooperate with each other to provide a cutting function for trimming the ceramic sheet laminate 1 into a predetermined shape by removing peripheral excess portions of the laminate.

The upper head 2 is further provided with an air port 14 communicating with the recess 10. The air port 14 is selectively connectable to a vacuum source 15 (e.g. vacuum pump) and a compressed air source 16 (e.g. air compresser) through lines 17, 18 provided with valves 19, 20, respectively.

A sealing sleeve 21, which may be square or rectangular in cross section (see Fig. 3), is fitted around the projecting central portion of the lower head 3 to be slidable vertically.

The sleeve 21 is elastically supported at its lower end by a plurality of springs 22 in a manner such that the upper end of the sleeve 21 is normally higher than the ceramic sheet laminate 1 placed on the lower press die 5. The sleeve 21 is internally provided with a seal ring 23 for sealing contact with the projecting central portion of the lower head 3. Similarly, the upper end of the sleeve 21 is also provided with another seal ring 24 for sealing contact with the bottom face of the upper head 2 around the recess 10.

The sealing sleeve 21 is also provided with a suction port 25 which communicates with the interior space of the sleeve. The suction port 25 is connected to the vacuum source 15 through a line 26 which is provided with a valve 27.

In operation of the heater press described above, the embedded heaters 6, 7 of the respective press dies 4, 5 are energized for heating, and the ceramic sheet laminate 1 is placed on the lower press die 5, as shown in Fig. 1. The introduction of the ceramic sheet laminate 1 is performed by utilizing a gap between the upper head 2 and the sealing sleeve 21 when the press is in the open condition of Fig. 1.

Then, the lower press die 5 together with the lower head 3 is raised by the hydraulically driven plunger 18. As a result, the upper end (namely, the seal ring 24) of the sealing sleeve 21 first comes into sealing contact with the underside of the upper head 2 to hermetically close the recess 10 and the interior space of the sealing sleeve 21, as shown in Fig. 4. Further, with a slight delay, the ceramic sheet laminate 1 on

the lower press die 5 is forcibly inserted into the frame die 13, whereupon the laminate 1 is trimmed at its outer periphery by the cutting function provided by the combination of the lower press die 5 and the frame die 13 while also pressed in the laminate direction between the upper and lower press dies 4, 5 under heating.

On the other hand, slightly before or while heat-pressing the ceramic sheet laminate 1 between the upper and lower press dies 4, 5, the vacuum source 15 is brought into communication with the recess 10 and the interior space of the sealing sleeve 21 by opening the valves 19, 27 with the other valve 20 closed. As a result, the volatile substances and/or air existing between the layers of the laminate 1 is forcibly evacuated, thereby shortening the time required for heat-pressing the laminate 1 without foam formation.

The evacuation with respect to the recess 10 and the interior space of the sleeve 21 may be performed only for a suitable period prior to heat-pressing the ceramic sheet laminate. Alternatively and preferably, such evacuation may be performed continuously for a longer period before, during and after the heat-pressing.

After the heat-pressing, the valves 19, 27 are closed to stop the vacuum application, and the upper and lower press dies 4, 5 are lowered by lowering the respective plungers 11, 18 to push out the ceramic sheet laminate 1 from the frame die 13, as shown in Fig. 5. In this process step, the upper press die 4 may be lowered simultaneously with the lower press die 5.

Alternatively, the upper press die 4 may be lowered after the lower press die 5 is first lowered.

Then, the lower press die 5 together with the lower head 3 is further lowered, whereas the upper press die 4 is raised, as shown in Fig. 6. As a result, the sealing sleeve 21 is brought away from the upper head 2, and the upper press die 4 is detached from the ceramic sheet laminate 1 which is left on the lower press die 5. Obviously, the heat-pressed laminate 1 can be taken out of the heater press by way of the gap between the upper head 2 and the sleeve 21.

On the other hand, in timed relation with the lowering and subsequent raising of the upper press die 4, the valve 20 is opened to bring the compressed air source 16 into communication with the recess 10. As a result, the flow of the compressed air serves to remove the cut fragments or like of the trimmed laminate 1 off the frame die 13. Further, even if the laminate 1 remains stuck to the upper press die 4 upon raising the upper press die, the flow of the compressed air is effective for releasing the laminate 1 off the upper press die 4.

According to the first embodiment described above, the sealing sleeve 21 is slidably fitted around the projecting central portion of the lower head 3 and elastically supported by the springs 22. Such an arrangement allows the lower press die 5 to move upwardly for heat-pressing the ceramic sheet laminate 1 even after the sleeve 21 comes into sealing contact with the upper head 2 for hermetically closing the recess 10 and the interior space of the sleeve 21. Thus, it is possible to

evacuate the recess 10 and the sleeve interior space prior to and during heat-pressing the laminate 1.

On the other hand, the sealing sleeve 21 can be brought away from the upper head 2 simply by lowering the lower head 3 beyond a predetermined amount, as clearly shown in Figs. 1 and 6. Thus, the gap formed between the upper head 2 and the sleeve 21 can be conveninently utilized for introducing and taking out the ceramic sheet laminate 1 relative to the heater press.

Further, the frame die 13 at the recess 10 cooperates with the lower press die 5 for trimming the ceramic sheet laminate 1 to have a predetermined shape and a predetermined size. Therefore, prior to the heat-pressing, the laminate 1 itself need not be strictly shaped and sized.

Moreover, the upper press die 4 is downwardly projectable out of the recess 10 according to the first embodiment. Thus, even if the ceramic sheet laminate 1 is jammed in the frame die 13 at the time of the heat-pressing, the laminate 1 can be conveniently forced out of the frame die 13 without deformation by lowering the upper press die 4 (see Fig. 5), thereby facilitating subsequent removal of the laminate 1 from the heater press.

Figs. 7 and 8 show a heater press according to a second embodiment of the present invention. The heater press of this embodiment differs from that of the first embodiment in that the former employs more than two press dies for heat-pressing a plurality of ceramic sheet laminates at a time.

Specifically, the heater press of the second embodiment comprises an upper head 2a fixed to a machine frame 9a, a lower head 3a movable vertically by a hydraulically driven plunger 18a, and an intermediate head 29 arranged between the upper and lower heads 2a, 3a. The intermediate head 29 is guided by a plurality of vertical guide rods 28 to be vertically slidable.

The underside of the upper head 2a carries an upper heating press die 4a which is provided with an embedded heater (not shown), whereas the upper side of the lower head 3a carries a lower heating press die 5a which is also provided with an embedded heater (not shown). Further, the intermediate head 29 is provided with a vertically spaced pair of intermediate press dies 29a, 29a' each of which is provided with an embedded heater (not shown). As clearly appreciated from Fig. 7, the upper one 29a (hereafter referred to as "first intermediate press die") of the intermediate press dies cooperates with the upper press die 4a for heat-pressing a ceramic sheet laminate 1 placed on the first intermediate press die 29a, whereas the lower one 29a' (hereafter referred to as "second intermediate press die") of the intermediate press dies cooperates with the lower press die 5a for heat-pressing another laminate 1 placed on the lower press die 5a.

A sealing sleeve 21a, which may be square or rectangular in cross section, is fitted on the upper head 2a to be slidable vertically as elastically supported by a group of springs 22a. Similarly, another sealing sleeve 21a', which may be also square or rectangular in cross section, is fitted on the lower head 3a

to be slidable vertically as elastically supported by another group of springs 22a'.

The sealing sleeve 21a for the upper head 2a is provided with a suction port 25a connectable to a vacuum source 15a (e.g. vacuum pump) via a line 26a which is provided with a valve 27a.

Similarly, the intermediate head 29 is provided with another suction port 25a' which is also connectable to the vacuum source 15a by way of the valve 27a. Reference signs 23a, 23a', 24a, 24a' in Fig. 7 represent seal rings for hermetically closing the relevant spaces in which heat-pressing takes place.

In operation, a ceramic sheet laminate 1 is placed on the first intermediate press die 29a, whereas another ceramic sheet laminate 1 is placed on the lower press die 5a.

Then, the lower head 3a is vertically raised by the plunger 18a. As a result, the sealing sleeve 21a' associated with the lower head 3a comes into sealing contact with the intermediate head 29 which in turn comes subsequently into sealing contact with the other sealing sleeve 21a associated with the upper head 2a, thereby forming two hermetically closed spaces. Further, the lower press die 5a approaches the second intermediate press die 29a' while the first intermediate press die 29a approaches the upper press die 4a, thereby heat-pressing the respective ceramic sheet laminates 1.

On the other hand, the valve 27a is opened after the two spaces accommodating the respective ceramic sheet laminates 1 are hermetically closed, thereby evacuating the hermically closed spaces. In this way, the heat-pressing operation can be

performed under evacuation for defoaming the laminates 1.

Obviously, the second embodiment of Figs. 7 and 8 is advantageous in that the productivity of heat-pressing is doubled because the two ceramic sheet laminates are treated at a time.

According to the second embodiment, no trimming is performed in the heater press with respect to each of the two ceramic sheet laminates 1. In this case, therefore, the heater press need not have a cutting function, which further makes it unnecessary to utilize a compressed air source required for removing cut chips or fragments. Further, due to the absence of a frame die (see the element 13 in Fig. 1), it is also unnecessary to make the upper press die 4a vertically movable because such is required only for pushing out the ceramic sheet laminate 1 from the frame die.

Fig. 9 shows a principal portion of a heater press according to a third embodiment of the present invention. The heater press of this embodiment comprises a fixed upper head 2b carrying an upper press die 4b and provided with a suction port 25b, a vertically movable lower head 3b carrying a lower press die 5b for placing a ceramic sheet laminate 1, and a sealing sleeve 21b fitted on the lower head to surround the lower press die 5b.

A unique feature of the third embodiment resides in that the sealing sleeve 21b itself is made of a relatively soft elastic material such as heat-resistant rubber. When the lower head 3b moves upward, the sealing sleeve 21b comes into sealing

contact with the upper head 2b to enable vacuum application through the suction port 25b. Upon further upward movement of the lower head 3b, the sealing sleeve 21b is elastically deformed while keeping the sealing contact with the upper head 2b, thereby making it possible to heat-press the ceramic sheet laminate 1.

Obviously, the third embodiment is advantageous in that the heater press can be extremely simple in arrangement and therefore very inexpensive.

While the present invention is described on the basis of the three embodiments, it is obvious that the same may be modified in many ways. For instance, the upper head 2, 2a, 2b may be rendered vertically movable, whereas the lower head 3, 3a, 3b may be rendered stationary. Alternatively, both of the upper and lower heads may be made vertically movable.

Further, instead of making the upper press die 4 of the first embodiment vertically movable, the lower press die 5 may be render vertically movable into and out of a recess which is formed in the lower head 3.

Moreover, the sealing sleeve 21, 21b of the first or third embodiment may be provided on the side of the upper head 2.

C L A I M S

1. A method for heat-pressing a laminate of ceramic sheets in the direction of lamination by a pair of press dies each provided with a heater, characterised in that the method comprises the steps of:

forming a hermetically closed space which entirely encloses the laminate interposed between the pair of press dies;

evacuating the hermetically closed space; and

heat-pressing the laminate between the pair of press dies.

2. An apparatus for heat-pressing a laminate of ceramic sheets comprising a pair of press dies for pressing the laminate in the direction of lamination, each of the press dies being provided with a heater, characterised in that the apparatus further comprises:

a sealing sleeve for forming a hermetically closed space which entirely encloses the laminate interposed between the pair of press dies; and

means for evacuating the hermetically closed space.

3. The apparatus according to claim 2, wherein the sealing sleeve is mounted on a first head which supports one of the press dies, the other press die being supported by a second head, at least one of the first and second heads being movable for bringing the pair of press dies toward and away from each other, the sealing sleeve coming into sealing contact with the

second head for forming the hermetically closed space when the pair of press dies are brought toward each other for heat-pressing the laminate.

4. The apparatus according to claim 3, wherein the sealing sleeve is slidably mounted on the first head and elastically supported by springs.

5. The apparatus according to claim 3, wherein the sealing sleeve is made of a relatively soft elastic material.

6. The apparatus according to any one of claims 2 to 5, wherein one of the press dies is supported on a head which is formed with a recess, said one press die being projectable from and retractable into the recess.

7. The apparatus according to claim 6, wherein the recess has an open mouth receiving a frame die into which the other press die is insertable, the frame die cooperating with said other press die for trimming the outer periphery of the laminate when said other press die is inserted into the frame die.

8. The apparatus according to claim 6 or 7, further comprising means for supplying compressed air into the recess when the other press die retreats out of the frame die.

9. The apparatus according to any one of claims 2 to 8, wherein

claim 6 or 7, further comprising:

an additional pair of press dies for pressing an additional laminate of ceramic sheets in the direction of lamination, each of the additional pair of press dies being provided with a heater;

an additional sealing sleeve for forming another hermetically closed space which entirely encloses the additional laminate interposed between the additional pair of press dies; and

means for evacuating said another closed space.

10. A method of heat pressing a laminate of ceramic sheets substantially as hereinbefore described with reference to any of Figures 1 to 12 of the drawings.

11. Apparatus for heat pressing a laminate of ceramic sheets substantially as hereinbefore described with reference to and as illustrated in any of Figures 1 to 12 of the drawings.

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Examiner's report to the Comptroller under Section 17
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Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES: WPI, CLAIMS

Documents considered relevant following a search in respect of Claims :-
1-11

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

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&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1367737 A	(HOLLANDSE SIGNAALAPPARATEN) Whole document	2, 3, 5
X	US 5069120 A	(SCHNEIDER) Whole document	2, 3, 9
X	US 4675066 A	(HONDA) Whole document	2, 3, 5, 9
X	US 4290838 A	(REAVILL) Whole document	2, 3, 5

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